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ABSTRACT

Computer-assisted instruction together with remedial reading classrooms for reading and regular classrooms for math has produced significant remedial gains in Chapter I students in Lafayette Parish, Louisiana--gains which are above the national average for Chapter I. The computer provides a vehicle for daily drill at each child's level which adds significantly to standard classroom remediation. Four years of consistent gains in grades 5 to 8 have shown that it is possible to predict future gains for similar populations. The computer level gains have been validated by correlating them with the Science Research Associates (SRA) nationally standardized scores. Further validation of the domain of acquired skills produced on the computer was performed by demonstrating that students could solve math and reading comprehension problems in an independently derived curriculum, Assurance, Inc. of Tucson, Arizona. Time spent on computer assisted instruction is directly related to increased remedial progress. When insufficient time is devoted to daily computer drill, progress is significantly diminished. (Three tables of data are included.) (JK)

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# USING COMPUTER ASSISTED INSTRUCTION TO RAISE AND PREDICT ACHIEVEMENT IN CHAPTER I STUDENTS

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Computer assisted instruction together with remedial reading classrooms for reading and regular classrooms for math produces significant remedial gains in Chapter I students. The gains are above the national average for Chapter I. The computer provides a vehicle for daily drill at each child's level which adds significantly to standard classroom remediation. Four years of consistent gains in grades 5 to 8 have shown that it is possible to predict future gains for similar populations. The computer level gains have been validated by correlating them with SRA nationally standardized scores. Further validation of the domain of acquired skills produced on the computer was performed by demonstrating that students could solve math and reading comprehension problems in an independently derived curriculum, Assurance, Inc. of Tucson, Arizona.

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# USING COMPUTER ASSISTED INSTRUCTION TO RAISE AND PREDICT ACHIEVEMENT IN CHAPTER I STUDENTS

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The necessity for academic remediation for disadvantaged children was amply demonstrated in the 1960's. Chapter I (then called Title I) programs were established to provide language arts and math remediation. Research had clearly demonstrated that many disadvantaged children would fall behind and function many years below grade level, unless remedial assistance was provided. The initial emphasis was on providing remedial programs and the refinement of measurement of the effectiveness of the remediation was left for future years.

The process of remediation is challenging since each disadvantaged child is different. Some disadvantaged children do not require remedial assistance. The needs of each child can only clearly be ascertained with precise diagnostic testing and evaluation. The degree to which a given disadvantaged child has fallen below grade level and the skills areas which are deficient can only be determined by accurate testing. Different children in the same grade require varied remediation because their deficit areas vary. Progress from child to child is not constant over the school year. Devising adequate remedial instruction so that each child can make continuous remedial progress is a very challenging and demanding task. When a classroom teacher teaches below or above the level of her students, time is wasted because no remedial gain is being achieved. The children do not progress if they are taught what they already know nor can they progress if they are presented material which

they cannot comprehend. Teaching groups of remedial children and addressing the needs of each child in the process is very difficult to achieve.

The determination of precise deficits in a child requiring remediation and arranging a systematic method of dealing with the child's deficiencies is imperative. Careful measurement of each child's skill level in reading and/or math allows for an ideal remedial program. At the end of the school year, measurement of progress or gain is absolutely necessary to evaluate the effectiveness of remediation. Without measurement for planning of instruction and measurement of the year's outcome, a systematic, efficient program of remediation can never be achieved.

In the 1970's Lafayette Parish (County) Schools established a diagnostic-prescriptive teaching approach for Chapter I students. The CTBS (California Test of Basic Skills) was administered to all students in September to determine actual levels of knowledge in reading/language arts and mathematics. Teachers would group children into remedial groups and plan instruction based on test results and curriculum based assessment. Children were placed in small groups and received instruction for 50 minutes a day during the school year using curricula designed for remediation). The children continued to attend their regular reading and/or mathematics classes. At the end of the school year, measurement of gains was determined, utilizing the CTBS as the criterion. As the Lafayette Parish program became more refined, significant remedial gains in reading and math were achieved each year from 1975-1981. According to the CTBS, the remedial students gained 1 year in math and in reading.

The program concentrated especially during these years on students in grades 3 to 8. The remedial children served were 1 1/2 to 2 years below grade level in reading and/or math. Some children, therefore, received services in only one subject whereas others qualified for both areas.

The initial Chapter I evaluations in the 1960's and 1970's utilized a criterion referenced or content referenced approach. Evaluations were performed in September and in the Spring of the following year. This Fall-Spring test approach gave false calculations of gains by capitalizing on the children losing skills over the summer in reading and math. The Fall measurement was an inacurrate representation of baseline. The children rapidly gained or re-learned material loss over the summer which was probably 6-12 months of information in terms of grade equivalents. Their progress for the regular school year was then added to this summer regression artifact and large growth gains could be reported for the year.

To make matters worse, in the 1960's and 1970's, out-of-level testing was used. This means the children were given levels of an achievement test which was below their actual grade placement. For instance, a fifth grader may have been given a third or fourth grade test. This procedure was followed because the children in Chapter I were selected because they were below grade level. The goal of out-of-level testing is to measure the content domain of the gain. Although out-of-level testing provides a good measure of the content domain which a child has learned over the year, it does not provide an accurate representation of gains in reference to age-peers or the actual grade placement of the child. Furthermore, in an effort to obtain

some-type of norm referenced index, the out-of-level test procedures used the norms at the lower grade level to provide a percentile or grade equivalent gain for the school year. Since these norms were inappropriate for the ages or grade levels of the children, they provided an inflated appraisal of growth. Therefore, Fall to Spring testing, inappropriate levels of testing and inappropriate norms tended to inflate the evidence of gain in Chapter I programs. In instances in which only grade equivalents were used as standard scores, gains were made even more inaccurate.

In the 1980's, tests are predominantly administered Spring to Spring, norm-referenced , at grade level, with percentiles or NCE's used to measure growth and gain. This format is more scientifically precise and provides a better measure of Chapter I gain over the school year in comparison with children in the same grade and/or age. In this system, Chapter I children who are at or below the 30th percentile in the Spring, on a nationally standardized achievement test qualify for Fall placement. Most of the children will be again below the 50th percentile at the end of the following school year when compared to other students in their grade. In its present format, the measurement of Chapter I gains is more precise in comparing children with comparable children in their grade and/or age. Though more precise from the comparable grade and/or age perspective, the present system loses information because it does not sufficiently define the extent of growth and the domain of growth from one year to the next. When Chapter I children who are below grade placement in skills are tested at grade level with a nationally standardized test, the children are unable to answer many questions in reading and/or math and quickly arrive at material which they do not

understand. For example, if a fifth grade Chapter I child is at third grade level in reading and is given a fifth grade nationally stan dardized achievement test, the child will find few questions at the third or fourth grade level which he/she can answer on the fifth grade level test. In the subsequent year the child may be at the fourth grade level but will have to take the sixth grade test; there will be few fourth or fifth grade level questions which the child can answer on the sixth grade test. The domain of growth skills in a given subject area is not adequately measured for a remedial child when a norm-referenced, actual grade placement, nationally standardized achievement test is administered. To adequately describe the effectiveness of a remedial program, some type of content referenced, out of grade level testing is necessary. Therefore, when both norm referenced and content referenced testing are employed, a more accurate description of remedial progress is provided. The norm referenced test provides a precise description of a child's skills and growth in comparison with other students in the same grade; the content referenced measure provides a broader description of the breadth and variety of skills which a student has acquired over the school year.

In 1981, Lafayette Parish (County) began a computer assisted instruction program in reading and math for Chapter I students. The program was nationally validated by the U.S. Office of Education and adopted for usage in other states. The computer program utilized was devised by the Computer Curriculum Corporation of Palo Alto, California. The effectiveness of the program for the past four years has been validated by reading and math gains on the nationally standardized SRA norm referenced test. The remedial children are tested at grade level.

Percentile and NCE gain scores have demonstrated that Chapter I students in Lafayette Parish make gains which are above the national and state average gains in math. The gains in reading exceed the average gains for the state and in most years exceed the average national gains in reading (see Table 1).

TABLE I

COMPARISON OF AVERAGE GAINS
1984-87 (4 years)
UNITED STATES, LOUISIANA, LAFAYETTE CHAPTER I

Mathematics - NCE (Normal Curve Equivalents)

| United States | Louisiana | Lafayette Chapter I |
|---|---|---|
| 4.7 | .2 | 7.1 |

Reading - NCE (Normal Curve Equivalents)

| United States | Louisiana | Lafayette Chapter I |
|---|---|---|
| 3.0 | 2.2 | 3.5 |

The computer assisted instruction program has proven to be a consistently effective remedial tool. Students only spend ten minutes a day on the computer practicing skills at their specific levels. Students continue to receive classroom instruction at grade level in math and receive remedial reading instruction in special classes. In 1981 research, computer assisted instruction was proven to add a statistically significant component beyond what could be achieved in remedial or regular classroom instruction. It provides drill at each child's level and gives immediate feedback. Presentation of many problems by the computer in ten minutes (an average of 40 problems in math and 20 in reading) provides daily drill throughout the school year.

The nationally standardized achievement test, therefore, provides a scientifically precise measure of gain in reading and math by comparing

remedial students with other students in their grade. The remedial students make significant gains but when compared to other students, the remedial students are below the 50th percentile when they enter the remedial program and remain below the 50th percentile (as a group) at the end of the year. Grade level testing for remedial students presents a precise measurement comparison with other students in their grade who are approximately the same age.

Since data has been collected for four years and consistent gains of 7.0 NCE's (on SRA) have been obtained in math and 3.5 NCE's (on SRA) in reading, it is possible to predict similar gains for this year and future years. Computer assisted instruction of ten minutes per day is an effective remedial tool. The computer not only provides instruction at each child's level for hundred's of children, but provides the classroom teacher and remedial reading teacher with weekly print-outs of weaknesses and trouble spots. Classroom teachers use the computer print-outs to guide remedial instruction for whole classes and for each individual child.

Our research has shown that students should spend a maximum of 22 hours on the computer for math and 22 hours for reading. This is achieved by an intensive ten minutes of drill on all school days throughout the year. Our research shows that if students spend less than 12 hours per school year on computer assisted instruction, minimal gain is achieved. Therefore, time must be spent practicing reading and math in order for progress to be made. The computer program itself sets 90 percent mastery as a criterion for proceding to more difficult material. Consequently time spent on the computer is directly tied to a 90 percent mastery criterion.

The computer assisted instructional program utilized by Lafayette Parish, provides approximate grade equivalents for the organization of its reading and math curricula. These approximate grade equivalents can be utilized for description of placement levels of the remedial students at the beginning of the year. If these grade equivalents (students are actually selected for remediation based on the previous year's nationally standardized test percentiles) are used as a gage, the remedial students in our program are 1 to 2 years below grade level. At the end of the school year, they make 1 to 2 years academic growth, if the computer levels are again used for descriptive purposes (See Table 2 and Table 3).

TABLE 2

CHAPTER I MATHEMATICS GAINS FOR FOUR YEARS
GRADES 5-8
(n = number of students)

SRA Gains - NCE (normal curve equivalents)

| n | 1983-84 | n | 1984-85 | n | 1985-86 | n | 1986-87 |
|---|---|---|---|---|---|---|---|
| 542 | 5.7 | 667 | 8.8 | 587 | 6.5 | 678 | 6.9 |

SRA Gains - Grade Equivalents

| n | 1983-84 | n | 1984-85 | n | 1985-86 | n | 1986-87 |
|---|---|---|---|---|---|---|---|
| 542 | 1.3 | 667 | 2.2 | 587 | 1.4 | 678 | 1.3 |

CCC Gains - Grade Equivalents

| n | 1983-84 | n | 1984-85 | n | 1985-86 | n | 1986-87 |
|---|---|---|---|---|---|---|---|
| 551 | 2.02 | 538 | 1.88 | 574 | 1.86 | 662 | 2.03 |

TABLE 3
CHAPTER I READING GAINS FOR FOUR YEARS
GRADES 5-8
(n = number of students)

SRA Gains - NCE (normal curve equivalents)

| n | 1983-84 | n | 1984-85 | n | 1985-86 | n | 1986-87 |
|---|---|---|---|---|---|---|---|
| 569 | 3.7 | 644 | 4.6 | 765 | 2.5 | 713 | 3.6 |

SRA Gains - Grade Equivalents

| n | 1983-84 | n | 1984-85 | n | 1985-86 | n | 1986-87 |
|---|---|---|---|---|---|---|---|
| 569 | 1.4 | 644 | 1.5 | 765 | 1.3 | 775 | 1.1 |

CCC Gains - Grade Equivalents

| n | 1983-84 | n | 1984-85 | n | 1985-86 | n | 1986-87 |
|---|---|---|---|---|---|---|---|
| 470 | 1.41 | 522 | 1.50 | 677 | 1.55 | 674 | 1.44 |

By studying the curriculum guide for the computer program, it is possible to examine the domain of skills in reading and math which the computer has presented and the remedial students have mastered. Visual examination of the computer curriculum implied that the domain of skills which the students mastered over the school year was extensive and complex. The SRA NCE gains (based on grade level comparisons) are an under-representation of the nature and extent of knowledge gained by students over the school year.

According to the computer curriculum guide, the extent of mastery over the school year was very gratifying. Caution is in order, however, based on the imprecision of grade equivalent levels in general and the possibility that the computer curriculum's assignment of grade equivalent levels were biased so that students appeared to have mastered more than they really did. For example, a curriculum could be set so that skills per grade level equivalents were below national standards.

Fourth grade could really be equivalent to third grade and growth for the year from third to fourth could be only six months in skills.

In order to determine if the computer grade level norms were radically distorted, computer levels were correlated with a nationally standardized test, the SRA. Significant correlations between SRA levels and computer levels were demonstrated (average r = .26, when corrected for attention r = .51). Growth levels assessed by the SRA proved comparable to computer level growth, although some discrepancies were noted. The extensive domain of skills which the computer curriculum claimed the students were obtaining during the school year appeared to have some validity. Since, however, correlations between SRA scores and computer level scores were unable to adequately compare the domain of skills, another confirmatory procedure was pursued.

In order to assess in greater depth that computer instructional grade equivalents and that growth for the year were indicative of a true gain in knowledge by the students, another independent validation was pursued. The Assurance Corporation of Tuscon, Arizona has designed curricula from grades 1-12 in all subject matter areas. The material has been organized according to grade levels. The grade levels of the Assurance program have been validated against nationally standardized tests and the input of a committee of teacher representatives of 153 school districts. Listings of the domains of skills at each grade level are presented in a manual. The Assurance package provides 8,600 items in a computer test bank to assess the components of a domain list at every grade level. The Assurance program produces computerized test generation by random sampling of test bank items for each skill for each grade level. The computer scores the test and provides an analysis of

strengths and weaknesses in each category of a grade level domain.

The following procedure was used to validate the computer assisted curriculum by means of the Assurance curriculum. The SRA mean grade level equivalent for Spring of 1985 was obtained for all Chapter I students in fourth grade reading or math. Categories of skills from the Assurance curriculum, six months below the mean SRA level up to 2 years above this level, in both reading and math were chosen for selection on a computer generated test. The Assurance program was then allowed to generate a test of four items in each category. Sixth grade remedial students (who had been in fourth grade in Spring 1985) were given the test in September 1986. The purpose of the test was to measure the domain of skills acquired in the 1985-86 school year by these fifth grade remedial students.

In September 1986, remedial students who had been in fifth grade in 1985-86 demonstrated 75% or better mastery of third grade and fourth grade skills on the Assurance tests. Some students demonstrated fifth grade skills in isolated areas. The domain of knowledge acquired was broad and extensive. The students demonstrated generalization of knowledge from the computer assisted instruction curriculum to a novel curriculum. Their accuracy and level of mastery as a group was excellent. A similar procedure was then followed with remedial students at other grade levels. Confirmation of broad gains in domains of instruction was confirmed.

Our research has shown, consequently, that remedial students actually acquire a large repertoire of skills over each school year. The computer assisted instruction levels, though in grade equivalents and lacking in exactitude, are reflective of growth in a variety of

skills, equivalent to 1 to 2 years of class work. The Assurance curriculum, using independent test items from an independently derived curriculum, proves that the content domain acquired by remedial Chapter I students on the computer within a given year is an extensive group of skills. Although the SRA presents the students' functioning below the 50th percentile before and after a year of remediation in comparison to their grade peers, the computer assisted instruction curriculum and the Assurance curriculum provide evidence of extensive knowledge and skill growth in appropriate domains. The Assurance curriculum validates the broad expanse of the computer level gains. This confirmation adds to the already established validity of the SRA which had been used as an external validation of the computer program. It shows that remedial students acquire true proficiency and can solve many math or reading comprehension problems at their functioning levels. By pursuing content referenced and norm referenced measurement, the validity of Chapter I remedial reading and math gains is clearly proven.